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REMARKS

Claims 1, 2, 5 to 21, 23, 24, 37, 38, 40 to 47, and 49 remain pending.

Claims 1, 2, 5 to 21, 23, 24, 37, 38, 40 to 47, and 49 have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite. The Action stated that the distinction between the terms "silicone rubber" and "silicone resin" is unclear. The Action also refers to a passage in U.S. Patent No. 5,283,063 as being of interest, as the Action states "[a]rt appear to both terms as the same." (page 2, paragraph 2 of the Action).

Applicants respectfully disagree with this rejection because it is well accepted by those of ordinary skill in the art that "silicone resin" and "silicone rubber" are not the same thing. First, Applicants respectfully submit evidence that points out the distinction commonly recognized in the art, as exemplified in Exhibits A and B, attached hereto.

As stated in Exhibit A, for example, "silicone resins" are defined as "highly cross-linked siloxane systems. . . [where] cure of silicone resins usually occurs through the formation of siloxane linkages by condensation of silanols. Silicone resins change little on exposure to weather." By contrast, "silicone rubbers" also referred to as "silicone elastomers" are characterized by cross-linking silicone polymers of appropriate molecular weight to provide elastomeric properties "and can be categorized by the temperature conditions need to cure them properly, eg, room-temperature-vulcanization and heat-cured rubbers." Furthermore, "[t]he properties of silicone rubber

change with temperature." Kirk-Othmer Concise Encyclopedia of Chemical Technology, page 1064 (John Wiley & Sons, Inc. 1985).

Exhibit B confirms that "silicone resins" and "silicone rubbers" are different in form and in application. Hawley's Condensed Chemical Dictionary, page 1036 (Van Nostrand Reinhold, 1993). As stated therein, "silicone" can be in the form of "fluids, powders, emulsions, solutions, resins, pastes, elastomers." Additionally, a different use is attributed to each of these different forms, significantly, the applied uses of "resin" as opposed to "elastomer or silicone rubber."

The recognized differences between "silicone resin" and "silicone rubber", as applied to the present invention, are discussed in the specification. The specification distinguishes both structurally and functionally the silicone rubber powder particles and silicone resin bound to the particles. The specification states at page 8, lines 4 to 7, that silicone rubber powder particles are coated with silicone resin that is chemically bound thereto (structural distinction). The specification also states at page 7, lines 12 and 13 and lines 20 and 21, that silicone rubber particles are softer and smoother than silicone resin powders (and, intrinsically, than silicone resin) (functional distinction). The specification also states at page 7, lines 16 to 20, that silicone resin powders have less tendency to agglomerate than silicone rubber particles (functional distinction). The specification also states at page 8, lines 13 and 14, that silicone resin powders have more slip and lubricity than silicone rubber powder particles (functional distinction). The aforementioned structural and functional distinctions between silicone resin and silicone rubber provided in the specification provides sufficient definiteness, particularly in view of the ample evidence of the distinction

between silicone resin and silicone rubber, attached hereto as Exhibits A and B, such that the claimed invention is not indefinite for failing to particularly point out and distinctly claim the invention. .

Further regarding the rejection under 35 U.S.C. 112, second paragraph, the reference to the relationship of silicone rubber and silicone resin in U.S. Patent No. 5,283,063, lines 52 and 53, is not dispositive in view of the teachings in the specification and in Exhibits A and B, attached hereto, which clearly recognizes the differences between them.

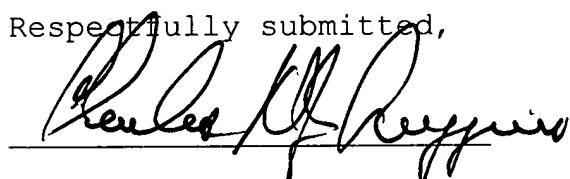
Claims 1, 2, 1(?), 23, 24, 37 to 47, 49, and 50 were rejected under 35 U.S.C. 103(a) as being unpatentable over EP 1136064 A2 (the EP publication), and, further in view of U.S. Patent No. 6,355,264 B1 (the Garrison patent) for reasons of record. The Action also stated the specification defines a preferred hybrid silicone is a vinyl dimethicone/methicone silsesquioxane crosspolymer. The Action further stated that since EP 1136064 A2 indicates the use of vinyl dimethicone/methicone crosspolymer, it meets the requirements of the claims. The Action still further stated that assertions that the Garrison patent does not disclose particles was not persuasive.

Applicants respectfully traverse this rejection in view of the differences between silicone resin and silicone rubber, as discussed above relative to the 35 U.S.C. 112, second paragraph rejection. Further, Applicants respectfully submit that, because of the differences between a silicone resin and a silicone rubber, the rejection under 35 U.S.C. 103(a) is rendered moot because none of the references cited in the Office Action teach

or suggest including a hybrid silicone powder having silicone rubber powder particles and a silicone resin chemically bound to the surface of the particles, as is recited by the pending claims. The two components of the hybrid silicone powder are distinct as is readily apparent from the disclosure in the specification relating to structure and function and from the generally accepted definitions of the two components, as exemplified by Exhibits A and B. The EP publication and the Garrison patent, that disclose one or more of the listed silicones, do not disclose the hybrid silicone powder because they do not refer to both a silicone resin AND a silicone rubber component. The claimed invention recites a hybrid silicone powder that requires both silicone rubber particles and a silicon resin coating chemically bonded therewith.

Reconsideration of claims 1, 2, 5 to 21, 23, 24, 37, 38, 40 to 47, and 49 is deemed warranted in view of the foregoing, and allowance of said claims is earnestly solicited.

Respectfully submitted,



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Exhibit A

KIRK-OTHMER

**CONCISE ENCYCLOPEDIA
OF CHEMICAL TECHNOLOGY**

A WILEY-INTERSCIENCE PUBLICATION

John Wiley & Sons

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1064 SILICON COMPOUNDS

Table 3. Properties of Siloxane Oligomers

Compound	Boiling point, °C/kPa ^a	Density d ²⁰ , g/cm ³	Refractive index, n _D ²⁰	Melting point, °C
[(C ₆ H ₅) ₂ SiO] ₄	335 _{0.13}			200
[(CH ₃)(C ₆ H ₅)SiO] ₄	237 _{0.13-0.67}	1.183	1.5461	99
(CH ₃) ₂ SiOSi(C ₆ H ₅) ₂ OSi(CH ₃) ₃	172 _{2.4}	0.984	1.4927	
[(CF ₃ CH ₂ CH ₃)(CH ₃)SiO] ₄	134 _{0.4}	1.255	1.3724	
[(CH ₂ —CH)(CH ₃)SiO] ₄	111 _{1.3}	0.9875	1.4342	-43.5
(CH ₃) ₂ Si[OSi(H ₂ CH ₃) ₂ OSi(CH ₃) ₃	177	0.8859	1.3854	
[(CH ₃)(H)SiO] ₄	134	0.9912	1.3870	-69

^aTo convert kPa to mm Hg, multiply by 7.5.

methylalkyl silicone. For lubricating grease, the fillers are generally lithium soaps and the preferred fluids are methylphenyl, chlorinated phenylmethyl, or methyltrifluoropropyl silicones. The electrical properties of silica-filled greases are good. Such dielectric compounds are workable at low temperatures and do not have a dropping point, as soap-filled greases do. Lubricating greases vary in properties, depending on the type of fluid and thickener used. They have wide service-temperature ranges, ie, from -70 to 230°C; dropping points of 200–260°C, depending on the soap used; low bleed; and low evaporation rate and weight loss in vacuum. Those based on fluids with good lubricating properties are themselves good lubricants, capable of prolonged performance up to 200°C.

Emulsions of silicone fluids in water are made for convenience in applying small amounts of silicone to textiles, paper, or other surfaces.

Silicone Resins

Silicone resins are highly cross-linked siloxane systems, and the cross-linking components are usually introduced as trifunctional or tetrafunctional silanes in the first stage of manufacture. The general effects of the most commonly used monomers on the properties of a film are listed in Table 5.

Dipping or impregnating varnishes based on silicone resins are used to bond and insulate electrical coils and glass cloth and are usually supplied as 50 wt% or 60 wt% silicone resins in an organic solvent.

Silicone laminating resins are used first to coat glass cloth, and this coating is partially cured to a nontacky stage. Stacks of cloth so treated are pressed at ca 7 MPa (1000 psi) and for high pressure laminates are heated to cure or are bag-molded or vacuum-formed at ca 0.7 MPa (100 psi) or less for low pressure laminates before cure.

Table 5. Effect of Monomers on the Properties of Silicone Resin Films

Property	CH ₃ SiCl ₃	C ₆ H ₅ SiCl ₃	(CH ₃) ₂ SiCl ₂	(C ₆ H ₅) ₂ SiCl ₂	CH ₂ (C ₆ H ₅)SiCl ₂
hardness	increase	increase	decrease	decrease	decrease
brittleness	increase	great increase	decrease	decrease	decrease
stiffness	increase	increase	decrease	decrease	decrease
toughness	increase	increase	decrease	decrease	decrease
cure speed	much faster	some increase	slower	much slower	slower
tack	decrease	some decrease	increase	increase	increase

Pressure-sensitive adhesives (qv) are made by compounding silicone elastomer gums with silicone resins which are not completely compatible with each other.

The cure of silicone resins usually occurs through the formation of siloxane linkages by condensation of silanols.

Silicone resins change little on exposure to weather.

Silicone Elastomers

Elastomers are an extremely important genus of silicone products. Silicone polymers of appropriate molecular weight must be cross-linked to provide elastomeric properties. Fillers are used in these formulations to increase strength through reinforcement. Extending fillers and various additives, eg, antioxidants, adhesion promoters, and pigments, can also be used to obtain specific properties (see also Elastomers, synthetic). The usual reinforcing fillers (qv) for silicone elastomers are finely divided silicas made by either the fume process or the wet process. Where physical strength is not required of the finished product, nonreinforcing fillers are used.

Different silicone elastomers are conveniently distinguished by their cure-system chemistries and can be categorized by the temperature conditions needed to cure them properly, eg, room-temperature-vulcanizing rubbers and heat-cured rubbers.

Properties. The properties of silicone rubber change with temperature; for example, Young's modulus decreases from ca 10,000 to 200 MPa (14.5×10^4 to 2.9×10^4 psi) from -50°C to RT and then remains fairly constant to 260°C. Resistivity decreases; electric strength does not change greatly; dielectric constant increases at 60-Hz current and decreases at 10⁴-Hz current and above; and the power factor increases considerably. Tensile strength decreases from ca 6.9 MPa (1000 psi) at 0°C to 2.1 MPa (300 psi) at 300°C. Thermal conductivity of silicone rubber usually is ca 1.5–4 W/(m·K) and increases with increased filler loading.

Table 4. Properties of Silicone Fluids

(CH ₃) ₂ SiO, mol %	Type of fluid	Viscosity at 25°C, mm ² /s			Pour point, °C	Flash point, °C	Surface tension at 25°C, mN/m	Electric strength, kV/μm
		d ²⁵ , (- cSt)	g/cm ³	n _D ²⁵				
100	none	10	0.940	1.399	-73	210	20.0	1.4
100	none	100	0.968	1.4030	-55	302	20.9	1.4
100	none	1,000	0.974	1.4035	-50	315	21.1	1.4
100	none	10,000	0.975	1.4035	-47	315	21.3	1.4
100	none	100,000	0.978	1.4035	-40	315	21.3	1.4
50	CH ₃ (C ₆ H ₅)SiO	125	1.07	1.495	-45	302	24.7	1.3
91.2	CH ₃ (C ₆ H ₅)SiO	50	0.99	1.425	-73	262	26.0	1.3
91.2	CH ₃ (C ₆ H ₅)SiO	100	0.99	1.425	-73	293	24.1	1.3
95.6	(C ₆ H ₅) ₂ SiO	100	1.00	1.421	-73	302	24.0	1.4
> 90	tetrachlorophenyl siloxane	70	1.045	1.428	-73	288	21	
0	CH ₃ (H)SiO	25	0.98	1.397			20	
0–10	CF ₃ CH ₂ CH ₂ (CH ₃)SiO	300	1.25		-48		26	
92	(CH ₃)SiO _{1.5}	50	0.972	1.403	-84	315	21.0	1.4

Silicone rubber (gum) films are permeable to gases and hydrocarbons and in general are ca 10-20 times as permeable as organic polymers. Gvents diffuse into silicone rubber and swell, soften, and weaken it. Heat alone can cause depolymerization and volatilization. Permanent deformation occurs when rubber is compressed or stretched at high temperature.

Health and Safety Factors

Methyl silicones are biologically inert. They do not react with body fluids, cause coagulation of blood, adhere to body tissues, and do not show irritating or toxic effects. These properties no doubt result from the molecular weight, incompatibility, and stability of the polymers. These qualities of the methyl polymers are usually also true of phenyl-, alkyl-, and fluoroalkyl-substituted polymers. Trifluoropropyl silicones, however, are toxic materials when heated above 280°C (see Biomedical and Prosthetic devices).

Formulated silicones contain ingredients that may be irritating or toxic. For example, some of the metallic or organometallic catalysts in silicones or RT-vulcanizing (RTV) rubbers are irritating or toxic, but they are used at very low levels in these products. By-products of elastomer cure may be irritating. Emulsifiers in silicone emulsions or bactericides used to keep these or silicone elastomers from deterioration are potential hazards. Many such products, however, are formulated to meet specific safety standards. Silicone resins are sold in solvents, and these may be hazardous with regard to health or fire.

Methylchlorosilanes are flammable and corrosive because HCl is liberated on hydrolysis; other chlorosilanes are less flammable, but all are hazardous chemicals. Volatile oligomeric siloxanes are somewhat flammable and can be generated by decomposition of siloxane polymers. Compounds containing SiH liberate hydrogen on hydrolysis or alcoholysis, and this is a hazard both in terms of flammability and generation of pressure.

A few other silicon compounds are toxic. For example, methyl and ethyl orthosilicates are somewhat toxic. Materials of this type may be used in formulating silicone products. It should not be assumed that

SILICON COMPOUNDS 1065

because silicone polymers are physiologically inert, all silicones and silanes are similarly benign, although this is usually the case.

Silicone rubber is generally resistant to bacterial or fungal growth, but bacterial growth has been noted in a few cases. This is probably caused by nonsilicone components in the composition, eg, fatty acids, but the net result is some ability to support growth.

A few low molecular weight silicone oligomers show varying biological activity. Hexamethyldisiloxane has toxic properties similar to that of many solvents and the methyltrifluoropropyl and methylphenyl trimers and tetramers are biologically active.

Uses

The range of silicone applications is extremely large and a compilation of general product types and example application areas is presented in Table 6.

BRUCE B. HARDMAN
ARNOLD TORKELSON
General Electric Company

R.R. McGregor, *Silicones*, McGraw-Hill Book Company, New York, 1954.

E.G. Rochow, *An Introduction to the Chemistry of the Silicones*, John Wiley & Sons, Inc., New York, 1951.

W. Noll, *Chemistry and Technology of Silicones*, Academic Press, Inc., New York, 1968.

M.D. Beers, in I. Skeist, ed., *Handbook of Adhesives*, D. Van Nostrand Company, New York, 1977.

W.J. Bobear in M. Morton, ed., *Rubber Technology*, 2nd ed., D. Van Nostrand Company, New York, 1973.

SILYATING AGENTS

Silylation of Organic Compounds

- Silylation is the displacement of active hydrogen from an organic molecule by a silyl group. The active hydrogen is usually OH, NH, or SH, and the silylating agent is usually a trimethylsilyl halide or a nitrogen-functional compound. A mixture of silylating agents may be used.

Derivatizing an organic compound for analysis may require only a few drops of reagent selected from silylating kits supplied by laboratory supply houses. Commercial synthesis of penicillin requires silylating agents purchased in tank cars from the manufacturer.

Typical commercial silylating agents are listed in Table 1.

All of the silylating agents are classified by the Department of Trans-

Table 1. Methyl Silylating Agents

Chemical name	Formula
trimethylchlorosilane (TMCS)	(CH ₃) ₃ SiCl
dimethyl dichlorosilane (DMCS)	(CH ₃) ₂ SiCl ₂
hexamethyldisilazane (HMDZ)	(CH ₃) ₃ SiNHSi(CH ₃) ₃
chloromethyl dimethylchlorosilane (CMDMS)	ClCH ₂ (CH ₃) ₂ SiCl
N,N'-bis(trimethylsilyl)urea (BSU)	((CH ₃) ₃ SiN) ₂ CO
N-trimethylsilyldiethylamine (TMSDEA)	(CH ₃) ₃ SiN(C ₂ H ₅) ₂
N-trimethylsilylimidazole (TSIM)	(CH ₃) ₃ Si—N—C≡N
N,O-bis(trimethylsilyl)acetamide (BSA)	(CH ₃) ₃ SiN=C(CH ₃)OSi(CH ₃) ₃
N,O-bis(trimethylsilyl)trifluoroacetamide (BTFCA)	(CH ₃) ₃ SiN=C(CF ₃)OSi(CH ₃) ₃
N-methyl-N-trimethylsilyl trifluoroacetamide (MSTFA)	(CH ₃) ₃ SiN(CH ₃)COCF ₃
t-butyltrimethylsilylimidazole (TBDMIM)	t-C ₄ H ₉ (CH ₃) ₂ Si—N—C≡N
N-trimethylsilylacetamide (MTSA)	(CH ₃) ₃ SiNHCOCH ₃

Table 6. General Product Types and Example Application Areas

Fluid applications	
plastic additives	greases
hydraulic fluids	coagulants
vibration damping	particle and fiber treatments
release agents	cosmetic and health-product additives
antifoamers	heat-transfer media
dielectric media	polishes
water repellency	lubricants
surfactants	
Resin applications	
varnishes	electrical insulation
paints	pressure-sensitive adhesives
molding compounds	laminates
protective coatings	release coatings
encapsulants	adhesives
junction coatings	
RTV rubber applications	
sealants	encapsulants
adhesives	electrical insulation
conformal coatings	glazing
gaskets	medical implants
foams	surgical aids
molding parts	mold making
Heat-cured rubber applications	
tubing and hoses	auto-ignition cable and spark-plug boots
beltting	extruding
wire-cable insulation	medical implants
surgical aids	laminates
fuel-resistant rubber parts	electrically conducting rubber
penetration seals	fabric coating
molded parts	foams
embossing-calendering rollers	

Exhibit B

Hawley's

Condensed Chemical

Dictionary

TWELFTH EDITION

Revised by

Richard J. Lewis, Sr.



VAN NOSTRAND REINHOLD COMPANY

New York

SILICON, AMORPHOUS

1036

silicon, amorphous. A non-crystalline allotrope of silicon that exists in the form of a dark-brown powder. It is made from silane (SiH_4) plus doping agents in a glow-discharge tube at low pressure. A film only a few microns in thickness is deposited on a glass or metal substrate. The amorphous product contains about 20% hydrogen. It has been found superior to crystalline silicon in the manufacture of solar cells.

silicon-bronze. An alloy of copper, tin, and silicon used for telephone and telegraph wires.

silicon carbide. CAS: 409-21-2. SiC .

Properties: Bluish-black, iridescent crystals. Mohs hardness 9, d 3.217, sublimes with decomposition at 2700°C, insoluble in water and alcohol, soluble in fused alkalies and molten iron. Excellent thermal conductivity, electrically conductive, resists oxidation at high temperatures. Non-combustible, a nuisance particulate.

Derivation: Heating carbon and silica in an electric furnace at 2000°C.

Available forms: Powder, filament, whiskers (3 million psi), single crystals.

Use: Abrasive for cutting and grinding metals, grinding wheels, refractory in non-ferrous metallurgy, ceramic industry and boiler furnaces, composite tubes for steam reforming operations. Fibrous form used in filament-wound structures and heat-resistant, high-strength composites.

Hazard: TLV: 10 mg/m³ in air.

See also "Carborundum," "Carbofrax."

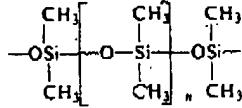
silicon-copper. (copper silicide).

Properties: A hard, tough, bronze-like alloy containing 10-30% silicon.

Derivation: From silica and copper electrolytically.

Use: Manufacture of silicon-bronze.

silicone. (organosiloxane). Any of a large group of siloxane polymers based on a structure consisting of alternate silicon and oxygen atoms with various organic radicals attached to the silicon:



Discovered by Kipping in England in 1900.

Properties: Liquids, semi-solids, or solids depending on molecular weight and degree of polymerization, viscosity ranges from less than 1 to more than 1 million centistokes. Polymers may be straight-chain, or cross-linked with benzoyl peroxide or other free radical initiator, with or

without catalyst. Stable over temperature range from -50 to +250°C. Very low surface tension; extreme water repellency; high lubricity; excellent dielectric properties; resistant to oxidation, weathering, and high temperatures; permeable to gases. Soluble in most organic solvents; unhalogenated types are combustible.

Derivation: (1) Silicon is heated in methyl chloride to yield methylchlorosilanes; these are separated and purified by distillation and the desired compound mixed with water. A polymeric silicone results. (2) Reaction of silicon tetrachloride and a Grignard reagent (RMgCl), with subsequent hydrolysis and polymerization.

Forms: fluids, powders, emulsions, solutions, resins, pastes, elastomers.

Use (Liquid): Adhesives, lubricants, protective coatings, coolants, mold-release agents, dielectric fluids, heat transfer, wetting agents and surfactants, foam stabilizer for polyurethanes, diffusion pumps, anti-foaming agent for liquids, textile finishes, water repellent, weatherproofing concrete, brake fluids, cosmetic items, polishes, foam shields in solar energy collectors, rust preventives. (Resin) Coatings, molding compounds, laminates (with glass cloth), filament winding sealants, room-temperature curing cements, electrical insulation, impregnating electric coils, bonding agent, modifier for alkyd resins, vibration-damping devices. (Elastomer, or silicone rubber): Encapsulation of electronic parts; electrical insulation; gaskets; surgical membranes and implants; automobile engine components; flexible windows for face masks, air locks, etc.; miscellaneous mechanical products.

See organosilicon, "RIV."

silicone oil. See silicone properties and uses.

silicone rubber. See silicone properties and uses.

silicon-gold alloy. See gold-silicon alloy.

silicon monoxide. CAS: 10097-28-6. SiO .

Properties: Amorphous, black solid. D 2.15-2.18, sublimes at high temperature, hard and abrasive. Non-combustible.

Grade: Lumps, powders, tablets; optical.

Use: To form thin-surface films for protection of aluminum coatings, optical parts, mirrors, dielectrics, or insulators.

silicon nitride. Si_3N_4 .

Properties: Gray, amorphous powder (can be prepared as crystals). Sublimes at 1900°C, d 3.44, bulk d 70-75 lb/cu ft depending on mesh, Mohs hardness 9+, thermal conductivity 10.83 Btu/in²/sq ft/hr/F at 400-2400F. Resistant to oxidation, various corrosive media, molten alu-

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